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To: C. R. Richmond, Associate Director, Biomedical and Environmental Sciences

From: S. I. Auerbach, Director, Environmental Sciences Division

Subject: Monitoring Data and Reports for Oak Ridge-ERDA Facilities

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In the past year, staff members in the Environmental Sciences Division have reviewed some of the aquatic-monitoring data and monitoring reports prepared by UCC-ND for the Oak Ridge-ERDA facilities. These reviews were prompted, in part, by the need for information on mercury levels in the local environs, including Poplar Creek and Clinch River. In addition, we felt it necessary to review the available physical-chemical monitoring data prior to designing and implementing a biological sampling program to assess the impacts resulting from operation of the Oak Ridge Gaseous Diffusion Plant. During the course of these reviews, several questions were raised concerning the objectives of environmental monitoring at the ERDA facilities, the method of summarizing and reporting data, and requirements for interpretation of monitoring data. Results of trace metal analysis for Poplar Creek sediments provide several examples which illustrate specific questions that were raised.

In both the 1975 and the 1976 Monitoring Report for Oak Ridge-ERDA facilities (Y/UB-4 and Y/UB-6), concentrations of selected trace metals in Poplar Creek sediments were reported (Tables 26 and 28, respectively). The conclusion in the 1975 report is that "Insufficient comparative data precludes any quantitative analysis of this current sediment sample data," but that .... "Future plans include collection of additional samples from the upper west fork of Poplar Creek to determine background levels." The sediment sampling program in Poplar Creek was expanded in 1976, presumably to obtain additional comparative data, including background levels in streams not receiving effluents from ERDA facilities. The conclusion in the 1976 report, which contains results of the expanded program, however, is that "Evaluation of the ORGDP impact on sediment concentrations is complicated by the fact that Poplar Creek at ORGDP is, during much of the year, a part of Watts Bar Reservoir and thus, along that portion of the stream, simulates a settling basin for both Poplar Creek and East Fork Poplar Creek. A meaningful interpretation of the data cannot currently be made due to the relatively short time period over which the data have been collected." The fact that the lower section of Poplar Creek acts as a settling basin for suspended sediments in East Fork Poplar Creek and Poplar Creek has been known since Watts Bar Reservoir was formed. If the objective of the sediment sampling program is to determine the

role of ORGDP on metal concentrations, the monitoring program must obviously be designed to account for metals in both East Fork Poplar Creek and Poplar Creek sediments. It would seem that a program to accomplish this objective could have been designed when sediment monitoring was initiated and certainly modified to meet the objective after two years of data collection. It is our understanding, however, that sediment sampling still does not include stations in the East Fork Poplar Creek. Therefore, isolating the impact of ORGDP on metal concentrations in Poplar Creek and Clinch River sediments seems unlikely until stations on East Fork Poplar Creek are established and monitored regularly.

The manner in which sediment data are summarized in the reports raises questions about the validity of comparing sampling locations and dates. There is no indication of sample numbers or variation in mean concentrations within sampling locations. Are the differences in concentrations between stations statistically significant?

Analysis of the frequency distribution of mercury levels in Poplar Creek sediments (PCM 0 to PCM 5.2) shows that mercury concentrations in 1975 and 1976 do not follow a normal or a log-normal distribution in either year. Concentrations in 1975 follow a bimodal distribution, while in 1976 the distribution is not bimodal but is definitely skewed. The expected frequencies of mercury concentrations for the Chi square (χ^2) statistic were calculated from the observed frequencies in 1975 and 1976. The results of the test showed that the frequency distribution of mercury in Poplar Creek sediment in 1975 and 1976 were significantly different from each other. It is interesting to note that the observed frequency in the smallest concentration class (< 0.1 ppm of Hg) decreased from 1975 to 1976, while the observed frequency in the middle and largest classes (0.10 to 10 and > 10 ppm, respectively) increased, suggesting that mercury levels in Poplar Creek sediments may have increased from 1975 to 1976. The important point, however, is that since neither the 1975 nor 1976 data follow a normal distribution, the data must be transformed before comparing concentrations between sampling locations and dates. There is no indication in the monitoring reports as to how the mean concentrations of metals in sediments were calculated and what assumptions are made about the frequency distribution of the observed concentrations. Also, if Poplar Creek in the vicinity of ORGDP is a settling basin for suspended sediments, what is the basis for the 15 sampling stations in Poplar Creek and why are the station locations either not shown on a map or described?

The method of sediment analysis is incorrectly stated to be atomic absorption (page 16 of the 1976 report); whereas, according to J. C. White, an emission spectrograph (which has a substantially lower precision) was used for analysis of mercury and presumably all other metals. It is our understanding that mercury is now being analyzed by atomic absorption

but sediment mercury concentrations in 1975 and 1976 were determined by emission spectrometry.

A question was also raised about the absence of biological monitoring in aquatic environments. The 1972 Federal Water Pollution Control Act Amendments (Public Law 92-500) specifically requires that wherever appropriate each discharger conduct biological monitoring in receiving waters. The Act is very explicit and detailed in its requirements (Sections 308 and 504) that effects of pollutants be measured on aquatic life actually in receiving waters (not in laboratory aquaria) and monitoring be conducted to detect accumulation of pollutants in tissue of organisms representative of appropriate levels of the food chain. Such biological monitoring data would be helpful to our staff in making their assessment of the environmental impacts resulting from operation of the Oak Ridge Gaseous Diffusion Plant.

In summary, the consensus of the staff members reviewing the monitoring reports was that aquatic monitoring of physical-chemical parameters was, in general, poorly designed to define the effects of specific facilities on contaminant levels and to quantify changes in contaminant levels over time. In addition, there is too little attention given to statistical analysis of existing physical-chemical data and data interpretation. It is our experience that for monitoring programs to be effective in terms of costs and information, they must be designed with specific objectives in mind. Because a primary objective of monitoring is to define the environmental impacts of each facility, it is imperative that both the biotic and abiotic components be monitored. The absence of regular biological monitoring precludes the possibility of defining the effects of contaminants on biological populations in the receiving waters. Since we must rely on public documents which can be cited in our environmental assessment of ORGDP, these monitoring reports provide an important data source. We would, therefore, like to ensure that these reports provide comprehensive and reliable environmental data for use in the assessment.

Because of our concerns over the status of monitoring in the Poplar Creek-Clinch River drainage, we recommend that the current physical-chemical monitoring program for aquatic environments be evaluated with emphasis on the specific objectives and requirements of monitoring, selection of monitoring stations and parameters, and analysis and reporting of monitoring data. We also recommend that a routine biological monitoring program be incorporated in the program. Members of the Environmental Sciences Division are available to participate in an evaluation of the current monitoring program and to assist in the design and implementation of biological monitoring. I look forward to discussing these matters with you at your convenience.

SIA:jmd
cc: F. R. Bruce
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